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Polar Bear Research Program

Program Update and Recap of 2009 and 2010 Field Operations

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INTRODUCTION

We provide an update on the U.S. Geological Survey (USGS) polar bear research program and report on our 2009 and 2010 research field efforts on the southern Beaufort Sea (SB) polar bear subpopulation. We also report on upcoming field efforts for summer and autumn 2010. During this time period, much of our work was conducted as an on-going collaboration with the University of Wyoming (UWYO) and the U.S. Fish and Wildlife Service (USFWS), Marine Mammals Management office. Financial support for research comes through a variety of sources, including the USGS Alaska Science Center, USGS Climate Change Research Program, the U.S. Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE, formerly the Minerals Management Service), the U.S. Bureau of Land Management (BLM) and the National Science Foundation (through UWYO).

Our on-going core research relates to the study of polar bear demography and habitat use in the SB and refinement of our estimates and projections of polar bear population trends. This work requires on-going marking of polar bears for mark-recapture population modeling and deploying satellite tags to study bear movements and refine habitat selection models. The primary purpose of this research is to develop a better understanding of the response of polar bears to a changing Arctic and to reduce the uncertainty in our projections of future polar bear populations. This effort represents the continuation of long-term research that has been essential for establishing baselines and recognizing changes in the polar bear population of the SB.

PROGRAM UPDATE

Here we provide an overview of our active research projects and highlight major developments in our program, including changes in research direction and personnel.

Current Research Projects

In addition to our core research program on the long-term demography and habitat use of the SB population, our research program includes several focused efforts to address specific questions, often with separate funding. Currently, we are involved in the following studies:

- ***Demography and Behavior of Polar Bears Summering on Shore in Alaska.--*** The *Bureau of Ocean Energy Management, Regulation and Enforcement* is helping to support a 5-year project to learn more about polar bears on land. The SB polar bear population occurs in a divergent-ice ecoregion, where most polar bears spend the entire year on sea-ice, even as it retreats northward away from the coast, to its minimal extent in September. Recently, there have been indications of more polar bears using land and increased duration of land use during summer and autumn. From 2000 – 2005, the USFWS estimated that 3.7 – 8% of the SB population used land during summer and autumn. This observation is corroborated by USGS data of satellite-tagged polar bears, which suggest that less than 20% of satellite tagged bears stay on land during the ice minimum season. The apparent increasing numbers of bears on land raises questions of the importance of this strategy to the population trend, and also the immediate concerns of interactions between human activities and bears. The primary objectives of this project are to characterize the demography and ecology of polar bear use of land in SB. With this information, we can improve our understanding of the implications of prolonged on-land periods for the status and health of the polar bear population. Further we propose to provide data to assess the potential for polar bears to interact with communities and industry in the coastal area of the North Slope of Alaska. Later in this report, we describe the August 2009 field season of this work and plans for August, September and October 2010.

- ***Adaptive long-term fasting in land- and ice-bound polar bears: coping with ice loss in the Arctic?*** The USGS is collaborating with the UWYO and the USFWS on a *National Science Foundation* funded project entitled ***Adaptive long-term fasting in land- and ice-bound polar bears: coping with ice loss in the Arctic?*** The principal investigators are Drs. Henry Harlow and Merav Ben-David; John Whiteman is the Ph.D. student leading the project. The objectives are to: 1) determine whether polar bears that follow the ice pack north in the summer experience food deprivation similar to land-bound bears; 2) estimate the ability for prolonged adaptive fasting and skeletal muscle protein strength retention in polar bears spending summer/fall on ice versus land; and 3) model the potential population changes of polar bears based on the proportion of ice- and land-bound animals in the population in relation to future sea ice change. Below we report on field efforts in the spring and autumn of 2009 to gather information related to this project.

- **Collaborations with USFWS.** The USGS is collaborating with the USFWS (Eric Regehr) to 1) assess retention of non-collar satellite tags (glue-on and ear tag); and 2) in a capture-mark-resight (CMR) study to estimate abundance of polar bears on-shore in the summer. The USGS is deploying the non-collar satellite tags on polar bears and paint marks for use in the CMR study.

- **Den Habitat Map for the National Petroleum Reserve-Alaska.** In September 2010 the USGS will conduct ground-truthing of a polar bear maternal den habitat map for the National Petroleum Reserve – Alaska (NPRA). This work will identify the strengths and weaknesses of the den habitat map created from a fine-grained digital terrain model (DTM). The final map will eventually be provided to all interested user groups for their planning purposes.

USGS Decision to Temporarily Suspend Radio-collaring

For many years, the USGS has deployed VHF and satellite radio collars on polar bears. The data on locations of bears provided by these devices has allowed the USGS to describe polar bear habitat use and also to help delineate populations, and the collaring has been a vital part of our program. On 26 January 2010, the USGS polar bear research team made the decision that collaring of polar bears would be suspended, for the 2010 season, because of concerns of collar-related injury to research animals. This decision was based on two factors. First, we believe that recent modifications to collar designs may be contributing to neck injury. The use of collars equipped with GPS (global positioning system) capability has resulted in wider and stiffer collars compared to those used prior to 2004. Also, collars are now equipped with a time-release mechanism designed to assure that bears will not have to wear collars beyond their useful life. However, because of the electronics the collars carry, these releases have been attached right behind the ear of the bear. We believe this location of the release mechanism also has contributed to the stiffness of the collar and to its potential to chafe the necks and ears of bears on which they are attached. Until these recent collar modifications the frequency of injuries caused by collars was very low. With these modern collars, we are seeing higher frequencies of chafing and cuts behind the ears and we find this unacceptable. The second factor that has led to our decision to suspend collaring is due to the availability of human-harvested bowhead whale remains at villages and at a whaling camp. This has resulted in many bears becoming uncommonly obese, and this exacerbates their susceptibility to injury from radio collars. As increasing numbers of bears end up on land we have seen a greater number of bears visiting Cross Island and Kaktovik to feed on whale remains. Many of these bears get exceptionally fat and exceed the allowable tolerances of radio collars. Most of the collar-related injuries to polar bears we have observed appear related to feeding on subsistence-harvested whale remains. Although the suspension of collaring will temporarily compromise the ability of USGS to provide information on polar bear spatial patterns (e.g., habitat use, maternal denning, and how bears will respond to climate change), concern over the welfare of research animals has become over-riding. The USGS will resume collaring after an acceptable redesign is developed. Our goals are to build collars out of a smoother material that is less abrasive and more flexible. These changes to collar design should prevent the minor abrasions and cuts that seem to have increased in frequency in recent years. We have begun discussions with the collar

manufacturer on the feasibility of user operated remote release mechanisms. The intention of this device is to remotely release those collars without recapturing the bear. The USGS will be working directly with a radio-collar manufacturer to research and develop collar designs that will minimize the potential of injury to polar bears while still allowing us to collect the information that is critical to understand climate change impacts on this species.

Transition to Less Invasive Methods of Studying Polar Bears

Vigilance in monitoring the status of polar bear populations has become more important in recent years because of concerns of climate change impacts to the Arctic, the harvest of polar bears, and expansion of the petroleum industry. Additionally, continued data collection will be necessary to understand and explain the mechanisms that drive polar bear populations and to understand the capability of polar bears to adapt to future challenges. Two primary methods of research have been the foundation of our knowledge base for polar bears. These include capture-mark-recapture for estimating population status and to record physical/physiological measures of body condition, and radio collaring female polar bears to estimate population bounds, survival, habitat use, and maternal den ecology. Capturing polar bears, however, requires the use of immobilizing drugs, is stressful to the bear, potentially hazardous to bears and researchers, and requires the capture of an animal that is integral to the traditional lifestyles of coastal residents.

The past decade has seen advances in the use of genetic markers in wildlife research. This relatively new method provides an alternative to traditional capture-mark-recapture because the tissue samples necessary for determining an individual animal's genetic fingerprint can be collected in a non-invasive manner. Capture is not required; hence, exposure of the animal to stress or danger is minimized or eliminated. Additionally, collection of tissues for genetic analysis requires no immobilizing drugs. A small tissue sample (approximately the diameter of pencil lead and about 0.5" in length) can be obtained from a biopsy dart fired from a helicopter. Hair samples collected from barbed wire corrals can also be used to collect DNA samples. This has the potential to negate most of the need to capture polar bears for research. Continued capture of some polar bears will be necessary to deploy marks, radios, and to collect physiological measures. Collection of capture-mark-recapture data, however, could be done mostly through biopsy darting, instead of capturing the bear, as has been the common practice in the past. This will improve the welfare of study animals, reduce exposure of animals to immobilizing drugs, improve on the safety to bears and researchers, and possibly improve the precision of population estimates.

Subject to approval of all necessary permits, we intend to begin biopsy darting this autumn in our research of polar bears that use land during seasons of extensive ice retreat. We also hope (again, subject to approval of permits) to begin using biopsy

darting as a major component in our springtime capture-mark-recapture research in the SB**.**

Another less invasive technique that we are exploring is the feasibility of non-collar radio tags (i.e., glue-on and ear tag radios). We are working with the USFWS on assessing the retention and performance of non-collar tags. Non-collar tags have the potential to provide new insight on polar bear ecology for those individuals (i.e., males and subadults) that can not wear traditional radio collars safely.

New Research Initiative: Changing Arctic Ecosystems

In FY2010, the U.S. Geological Survey began a new research initiative entitled *Changing Arctic Ecosystems*. This new effort addresses the U.S. Department of Interior (DOI) need for new approaches to understand how changes in the ice-dominated ecosystems of the Arctic affect biological communities. The ice-dominated ecosystems are both marine (sea ice) and terrestrial (permafrost), and the research initiative includes themes structured to understand the linkages between physical processes, ecosystems and wildlife populations. *Theme I* of *Changing Arctic Ecosystems* addresses how changes in the sea ice ecosystem will affect polar bears and Pacific walruses. In the first five years of the *Changing Arctic Ecosystems* initiative, the USGS Alaska Science Center will build upon previous and ongoing studies of polar bears, focusing primarily on the SB population in Alaska. Funding from this new initiative will allow several new efforts to begin, including more detailed studies of polar bears on land and of polar bear sea ice habitats, development of habitat models for polar bears in the seasonal sea ice and archipelago ecoregions, and new lines of research on energetics and behavior. Results of these new efforts will provide critical information to our overall goal to understand both the demographic response of polar bears to a rapidly changing Arctic environment and the mechanisms of that response. Ultimately, information from the new initiative will be used to refine earlier projections of how climate change will affect polar bear populations throughout the 21st century

Personnel Changes

Dr. Lily Peacock, formerly the leader of polar bear research in Nunavut, has joined the USGS polar bear team to head up studies of onshore bears.

Dr. Jeff Bromaghin, formerly with the USFWS, has joined the USGS Alaska Science Center as a Research Statistician. Dr. Bromaghin will take the lead on future demographic analyses for the SB population and will work with Dr. Peacock in the onshore demography studies.

After over 30 years with the US federal government leading studies of polar bears, **Dr. Steven Amstrup** retired from federal service, as of July 31, 2010. Dr. Amstrup will

continue with USGS as a Scientist Emeritus. He will also be working for Polar Bears International.

RECAP OF 2009 AND 2010 FIELD OPERATIONS

Spring 2009

The purpose of the spring 2009 capture season was to maintain collection of our long term population data to allow quantification of vital statistics such as survival rates, reproductive rates, and body condition of polar bears in the SB. This field effort focuses on mark and recapture data to estimate population status, collection of tissues for genetic and health analysis, measuring polar bears to monitor body metrics, and deploying satellite tags to continue to collect habitat-use information.

In addition, as part of our collaborative research project with the UWYO, we surgically implanted temperature loggers into the sterna region of selected polar bears and took muscle biopsies. Collars deployed on these study bears had activity monitors and temperature sensors, and were equipped with automatic releases.

Capture operations occurred in the Alaskan region of SB between 24 March and 20 May, 2009. The USGS capture team flew 172.2 total hours in an Aerospatiale A-Star B2 helicopter. Approximately 97.2 hours (56%) were spent actively searching for polar bears, 12.7 hours (7%) were spent radio tracking previously collared bears, and 24.7 hours (14%) were spent in general observations or in flight operations related to darting polar bears for capture. Remaining hours were spent traveling for fuel or between logistic bases. Between 20 April, 2009 and 20 May, 2009 we had a second helicopter on site that carried the UWYO research crew. As in previous years, we searched the entire nearshore zone of the SB between Barrow and the Canadian border. We spent the first 2 weeks of the field season to the west in Barrow, then moved to the east in Kaktovik for 2 weeks, and spent the last 4 weeks in the Prudhoe Bay area in the central portion of the Beaufort Sea coast.

Recapture rates were higher in spring 2009 than in previous years (Table 1). We captured a total of 91 individual polar bears by standard search (i.e., random encounters while searching polar bear habitat) and 19 other individual polar bears by radio-satellite telemetry (Table 2, Fig.1). An adult female and an adult male were both captured twice on 2 separate occasions as they had previously been marked using an all-weather paint stick, which had faded over the course of the capture season. The proportion of adult (age ≥5 yr) polar bears captured by standard search was 0.41 female (25 females and 36 males). The age class composition of polar bears captured by standard search was 0.67 adult (5+ yr), 0.04 sub adult (3-4 yr), 0.12 yearling, and 0.16 cub-of-the-year (COY). We captured a total of 17 family groups by standard search (Table 3). We administered oxytocin to 25 adult female polar bears to collect milk samples. In addition to standard

measurements, we also performed bio-electric impedance analysis (BIA) on adult, sub-adult, and yearling polar bears (76 bears total). We collected blood, fat, hair, fecal, nasal swab, and toe swab samples from adult, sub-adult, and yearling polar bears, and ear punches from newly marked polar bears. A pre-molar tooth from independent bears was collected from bears that had not been previously aged. In addition, we collected seal samples from 19 different kill sites for future analyses of polar bear prey. We deployed 28 PTT (10 Argos Doppler and 18 Argos GPS) satellite collars on 27 adult female polar bears and 1 sub-adult male. Three of these collars (1 Doppler and 2 GPS) were immediately shucked by adult females. We also recovered 14 PTT (11 Doppler and 3 GPS) radio collars from bears collared in prior years.

As part of the collaborative study with the UWYO, we processed 19 adult female and 1 sub-adult male polar bears. We took 19 muscle biopsies and implanted abdominal temperature loggers in 16 of these individuals. Samples of breath from all available polar bears were taken for respiratory quotient and stable-isotope analysis.

August 2009

We conducted capture work in August as part of our continuing collaborative research project with the UWYO, as a first field season for the BOEMRE project, and to deploy non-collar tags for assessment of retention (USFWS).

Capture operations occurred onshore on the Alaskan southern Beaufort Sea coast between 3 and 29 August, 2009. We used 2 helicopters for this project; one for the USGS research team and a second for the UWYO research crew. The USGS capture team flew 56.9 total hours in an Aerospatiale A-Star B2 helicopter. Approximately 35.7 hours (63%) were spent actively searching for polar bears, 1.2 hours (2%) were spent radio tracking previously collared bears, and 4.3 hours (8%) were spent observing, herding, and darting polar bears during capture attempts; the remaining hours were spent traveling for fuel or in point to point flight operations. Work was based at the Oliktok Distant Early Warning Station near Deadhorse.

We captured a total of 13 individual polar bears by standard search and 5 individual polar bears by radio/satellite telemetry or reports from other organizations (Fig.1). All of the adult polar bears captured during this season had been previously captured. The sex ratio of adult polar bears captured by standard search was 0.63 female (5 females and 3 males). We captured 2 family groups by standard search (Table 3). The age class composition of polar bears captured by standard search was 0.62 adult (5+ yr), 0.08 two-year-old, and 0.31 cub-of-the-year (COY). We administered oxytocin to 1 adult female polar bear to collect a milk sample. In addition to standard measurements, we also performed BIA on 12 polar bears. We collected blood, fat, hair, and fecal samples from all bears. We also collected an ear punch samples from newly marked bears and a

tooth sample from independent bears that had not been previously aged. We deployed 10 PTT glue-on transmitters on 7 female and 3 male polar bears. We also deployed 5 PTT ear-tag transmitters on 3 female and 2 male polar bears. Three of these individuals (1 female and 2 males) received both a PTT glue-on and PTT ear-tag transmitter. We also recovered 1 PTT (ARGOS) radio collar from a bear collared in a prior year.

With the UWYO, we processed 5 adult female, 2 adult male, and 1 sub-adult female polar bears for the NSF study. We collected muscle biopsies from 5 bears, implanted abdominal temperature loggers in 6, and collected breath samples from all 8 polar bears.

October 2009

In October 2009, we conducted both onshore work and work in the ice pack, using support from the United States Coast Guard icebreaker *Polar Sea*.

Shore-based capture work

As a follow-up to the August field work, we conducted shore-based capture work in October for the second phase of the collaborative research project with the UWYO. The primary purpose of this capture season was to recapture as many polar bears that had been previously processed by the UWYO as possible to recover implanted temperature loggers, GPS radio collars, and activity monitors.

Capture operations occurred onshore of the Alaskan region of SB from 4 - 26 October, 2009. We again had 2 helicopters working with the project; one carried the USGS capture team, and the other the UWYO research crew. The USGS capture team flew 51 total hours in an Aerospatiale A-Star B2 helicopter. Approximately 24.6 hours (48%) were spent actively searching for polar bears, 6.8 hours (13%) for radio tracking previously collared bears, and 5.7 hours (11%) for observing, herding, darting, and slinging polar bears during capture attempts. The remaining hours were spent traveling for fuel or in point to point flight operations. We had satellite locations from Argos downloads, or visual observations provided by USFWS survey crews, for most of our targeted bears. This allowed us to devote less time to searching and more time to flying directly to the known location of bears. We worked out of the Prudhoe Bay area, in the central region of the southern Beaufort Sea for the duration of the field work.

We captured a total of 6 individual polar bears by standard search and 10 individual polar bears by radio/satellite telemetry or reports from USFWS survey crews (Fig.1). We captured one of these individuals, an adult female, on 2 separate occasions. All of the adult polar bears captured during this season had been previously captured. We captured 4 family groups (Table 3). The age class composition of captured polar bears

was 0.56 adult (5+ yr), 0.13 sub adult (3-4 yr), 0 two-year-old, 0.13 yearling, and 0.19 cub-of-the-year (COY). We administered oxytocin to 3 adult female polar bears to collect milk samples. In addition to standard measurements, we also performed bio-electric impedance analysis on 10 polar bears. We collected blood, fat, hair, and fecal samples from captured polar bears. We deployed 2 PTT (Argos GPS) glue-on transmitters on 2 female polar bears and 4 PTT (Argos Doppler) ear transmitters on 4 female polar bears. One of these individuals received both a PTT glue-on and PTT ear transmitter. We also recovered 7 PTT (2 ARGOS and 5 GPS) radio collars from previously collared bears.

For the UWYO study, we processed 6 adult female, 1 adult male, and 2 sub-adult female polar bears. We collected muscle biopsies from 8 of these individuals and recovered abdominal temperature loggers from 5 of these individuals. In addition, we collected samples of breath from all available polar bears.

Of the 10 glue-on transmitters deployed in August, 4 recaptured bears still had transmitters and 2 recaptured bears had lost their transmitters. For the remaining 4 bears that were not recaptured on October, satellite data indicated that 1 other transmitter had either dropped or stopped transmitting and the remaining 3 were still attached to the bear and continued to transmit. Of the 5 ear-tag transmitters deployed in August none of these bears could be confirmed as still having transmitters, 1 bear was recaptured that had lost her transmitter, and satellite data suggests all of these transmitters had dropped or stopped transmitting prior to the October capture season.

During the October 2009 on-shore capture operations one polar bear died when we attempted to capture it to remove a radio collar that had become tight and was causing a neck injury. This bear had been collared as part of University of Alberta research, led by Dr. Andrew Derocher, in the Canadian Beaufort Sea. After capture, however, she moved to Kaktovik where she fed on the remains of harvested bowhead whales and became extremely fat. The USGS research crew observed this bear on the barrier islands near Kaktovik on 18 October, 2009 and noted what appeared to be serious injuries to her neck. A decision was made by the USGS crew that the bear needed to be recaptured so that her collar could be removed. On capture the bear was found to be extremely obese (440 kg), and she had extensive neck damage from her collar, which had become too tight as a result of her extreme weight. Numerous other bears present at the site of her capture meant we had to relocate her to allow safe handling and to allow her to recover without being bothered by other bears. The bear stopped breathing during the relocation attempt, however, and could not be revived. We transported the bear to our logistic support base in Prudhoe Bay, and the bear was necropsied by Dr. Kathy Burek, a veterinary pathologist. Her necropsy confirmed that the bear died from suffocation. Moving anesthetized polar bears by helicopter sling is not part of USGS standard operating procedures and was employed in 2009 for emergency purposes. We are currently reviewing our procedures for safely moving bears under anesthesia to ensure safety of all bears we capture.

Icebreaker capture work

To capture bears summering on sea ice, we conducted capture work over the pack ice from an icebreaker as part of our collaborative research project with the UWYO. The primary purpose of this capture work was also to recapture as many polar bears that had been previously processed by the UWYO as possible to recover implanted temperature loggers, GPS radio collars, and activity monitors.

Capture operations occurred over the pack ice in the SB and Chukchi Sea between 29 September and 31 October, 2009. We had 2 helicopters working with the project; one carried the USGS capture team, and the other the UWYO research crew. The USGS capture team flew 44.5 total hours in a Bell 206 Long Ranger helicopter. Approximately 3.1 hours (7%) were spent actively searching for polar bears, 23.7 hours (53%) were spent radio tracking previously collared bears, and 4.4 hours (10%) were spent observing, herding, darting, and slinging polar bears during capture attempts; the remaining hours were spent traveling for fuel or in point to point flight operations. We had satellite locations for most of our targeted bears so we devoted less time to searching and more time to flying directly to the known location of bears. During the 5 weeks of this project, the majority of time was spent sailing the ice breaker to the vicinity of target polar bears. Targeted bears were widely dispersed across the Arctic, requiring transit times of 1-2 days or more to reach them. Once in the vicinity of target bears we launched the helicopters to locate and hopefully capture these individuals.

We captured a total of 6 individual polar bears by standard search and 11 individual polar bears by radio/satellite telemetry (Fig.1). One adult and 1 sub-adult had not been previously captured. We captured 6 family groups (Table 3). Ten individuals had been previously captured and 7 (1 adult, 1 sub-adult, and 5 cubs-of-the-year) had never been previously captured. The age class composition of captured polar bears was 0.47 adult (5+ yr), 0.06 sub adult (3-4 yr), and 0.47 cub-of-the-year (COY). We administered oxytocin to 2 adult female polar bears to collect milk samples. In addition to standard measurements, we also performed bio-electric impedance analysis on 7 polar bears. We collected blood, fat, hair, and fecal samples from all captured bears. Additionally, we collected ear punch samples from newly marked polar bears and a tooth sample from independent bears that had not been previously aged. We deployed 6 PTT (1 Argos Doppler and 5 Argos GPS) radio collars on adult female polar bears, one of which (GPS) was immediately shucked by the bear. We also recovered 6 PTT (2 Doppler and 4 GPS) radio collars from previously collared bears.

The UWYO processed 6 adult female and 1 sub-adult female polar bears. They took muscle biopsies from 6 of these individuals and recovered abdominal temperature loggers from 4 of these individuals. In addition, they collected samples of breath from all available polar bears.

Spring 2010

The purpose of the spring 2010 capture season was to maintain collection of our long term population data to allow quantification of vital statistics such as survival rates, reproductive rates, and body condition of polar bears in the SB. These field efforts focused on maintaining mark and recapture data, collection of tissues for analysis, measuring polar bears to monitor body metrics and deploying satellite tags to continue to collect habitat-use information.

Capture operations occurred in the Alaskan region of SB between 26 March and 4 May, 2010. The USGS capture team flew 102.9 total hours in an Aerospatiale A-Star B2 helicopter. Approximately 55.3 hours (54%) were spent actively searching for polar bears, 2.8 hours (0.03%) were spent radio tracking previously collared bears, and 19.0 hours (18.5%) were spent in general observations or in flight operations related to darting polar bears for capture. Remaining hours were spent traveling for fuel or between logistic bases. Between 17 April and 4 May, 2010 we had a second helicopter on site that carried the UWYO Research crew. This second helicopter searched for bears and kept bears away from water and other hazards during capture operations. As in previous years, we searched the entire nearshore zone of the SB between Barrow and the Canadian border. We spent the first 2 weeks of the field season to the west in Barrow, then moved to the east in Kaktovik for 2 weeks, and spent the last 10 days in the Prudhoe Bay area in the central portion of the Beaufort Sea coast. Due to bad weather, we were only able to fly 3 of the 10 days in the Prudhoe Bay area.

Recapture rates were higher this year than in previous years (Table 1). We captured a total of 61 individual polar bears by standard search (i.e., random encounters while searching polar bear habitat) and 15 other individual polar bears by radio-satellite telemetry (Table 4, Fig. 2). The proportion of adult (age ≥5 yr) polar bears captured by standard search was 0.51 female (19 females and 18 males). The age class composition of polar bears captured by standard search was 0.61 adult (5+ yr), 0.03 sub adult (3-4 yr), 0.07 two-year-old, 0.11 yearling, and 0.18 cub-of-the-year (COY). We captured a total of 11 family groups by standard search. We administered oxytocin to 15 adult female polar bears to collect milk samples. In addition to standard measurements, we also performed bio-electric impedance analysis (BIA) on adult, sub-adult, and yearling polar bears (53 bears total). We collected blood, breath, fat, hair, and fecal samples from all bears older than COY, and ear punches from newly marked polar bears. A pre-molar tooth from independent bears was collected from bears that had not been previously aged. In addition, we collected seal samples from 8 different kill sites for future analyses of polar bear prey. We deployed 33 PTT satellite tags (11 ear tag and 22 glue-on tags) on 25 adult female polar bears, 1 sub-adult female, and 7 adult males. We also recovered 5 PTT (3 Doppler and 2 GPS) radio collars from bears collared in prior years. As of July 2010, only 1 of the 33 non-collar tags deployed in spring 2010 remained operational.

August, September and October 2010

On shore capture work was attempted between 8 and 15 August 2010. The base of operations was Prudhoe Bay. An Aerospatiale A-Star B2 helicopter was used to search coastlines and barrier islands between the Canada border and Barrow, Alaska. Only 7 bears, including 1 adult female with 2 COYs, 3 adult males, and 1 sub-adult female were encountered after searching the entire coast. Additionally, only 3 sets of relatively fresh bear tracks were observed. Because of the proximity of open water the crew decided to forgo capturing of the 7 bears that were observed due to safety concerns for the bears. Because polar bears were largely absent on land the capture mission was aborted.

The paucity of bears on the coast was, relative to the past 10 years, unprecedented. The likely reason for this absence of bears on land was the presence of remnant sea ice from Flaxman Island west to Smith Bay and 80-95 kilometers north of the barrier islands (Figure 2). This ice patch was separated from the main pack by several hundred kilometers of ice-free ocean. The ice was composed of unconsolidated floes with an overall aerial concentration of 10-25% (Figure 3). This patchy ice over the continental shelf likely provided a suitable platform for nearshore bears, negating a need for bears to go to land.

Plans for September field work include distance sampling to estimate the distribution and abundance of polar bears using land, and captures for deployment of non-collar radio tags and to collect physiological measurements. During October a second distance sampling mission will be conducted in conjunction with biopsy darting to obtain genetic samples of bears (subject to receipt of permits).

Table 1. Adult (age ≥5 yr) polar bears captured in the spring 2002 - 2010 by standard search in the southern Beaufort Sea by the U.S. Geological Survey.

Year	Search hours	Total Captures	Encounter rate	Recaptures	Proportion Recaptured
2002	55.6	42	0.76	13	0.31
2003	72	54	0.75	14	0.26
2004	89.9	71	0.79	35	0.49
2005	74.2	54	0.73	32	0.59
2006	86	57	0.66	38	0.67
2007	85.6	54	0.63	33	0.61
2008	90.2	54	0.60	36	0.67
2009	97.2	61	0.63	44	0.72
2010	55.3	37	0.67	30	0.81

Table 2. Polar bears captured by standard search in the southern Beaufort Sea by the USGS, spring 2009 (Adult ≥ 5 yrs, Sub-adult = 3-4 yrs). Note that the capture of an independent yearling during spring has not been observed prior to 2009.

	Female	Male	Total
Adult (solitary)	8	36	44
Encumbered adult females	17	-	17
Sub-adults	1	3	4
Two-year-olds	0	0	0
Independent yearlings	0	1	1
Dependent yearlings	5	5	10
COY	7	8	15
Total	38	53	91

Table 3. Litter sizes of family groups captured in the southern Beaufort Sea by the USGS, 2009. Spring and August represent bears captured using standard search methods, while October shore and October Icebreaker include all captured family groups.

	Litters	Mean litter size	SE
Spring			
COY	10	1.5	0.17
Yearlings	7	1.4	0.20
August			
COY	2	2	
Yearlings	0	0	
October Shore			
COY	2	1.5	0.50
Yearlings	1	2	
October Icebreaker			
COY	6	1.3	0.21
Yearlings	0	0	

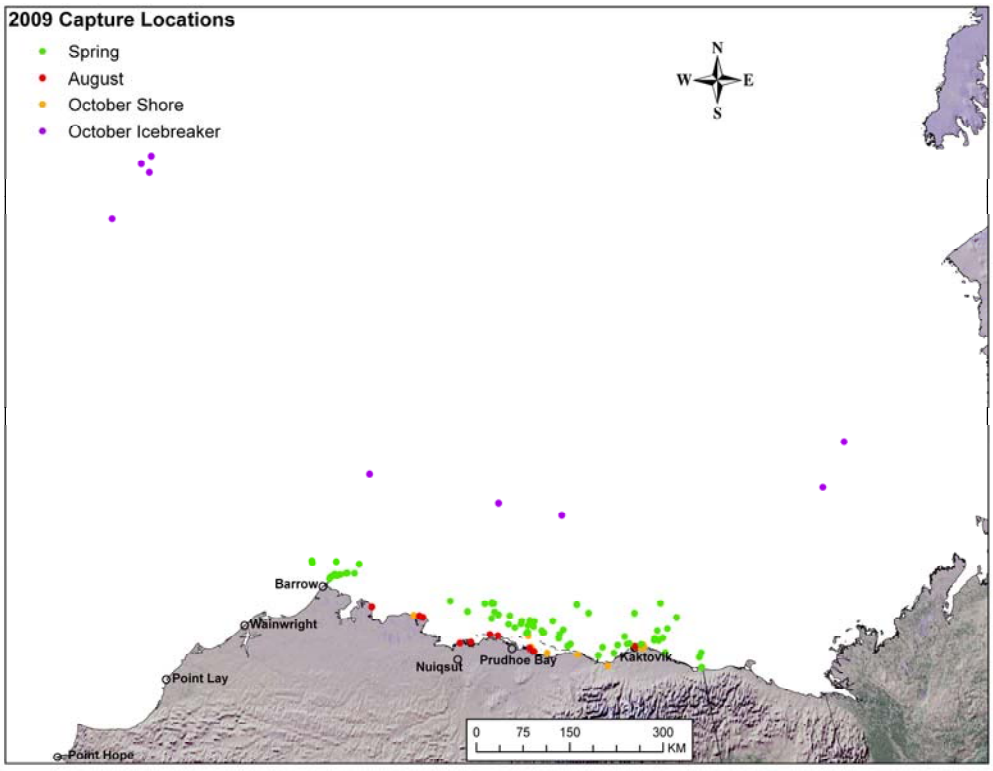
Table 4. Polar bears captured by standard search in the southern Beaufort Sea by the USGS, spring 2010 (Adult ≥ 5 yrs, Sub-adult = 3-4 yrs).

	Female	Male	Total
Adult (solitary)	8	18	26
Encumbered adult females	11	-	11
Sub-adults	1	1	2
Two-year-olds	2	2	4
Yearlings	2	5	7
COY	3	8	11
Total	27	34	61

Updated movements of satellite-tagged polar bears are available at

http://alaska.usgs.gov/science/biology/polar_bears/tracking.html

a)



b)

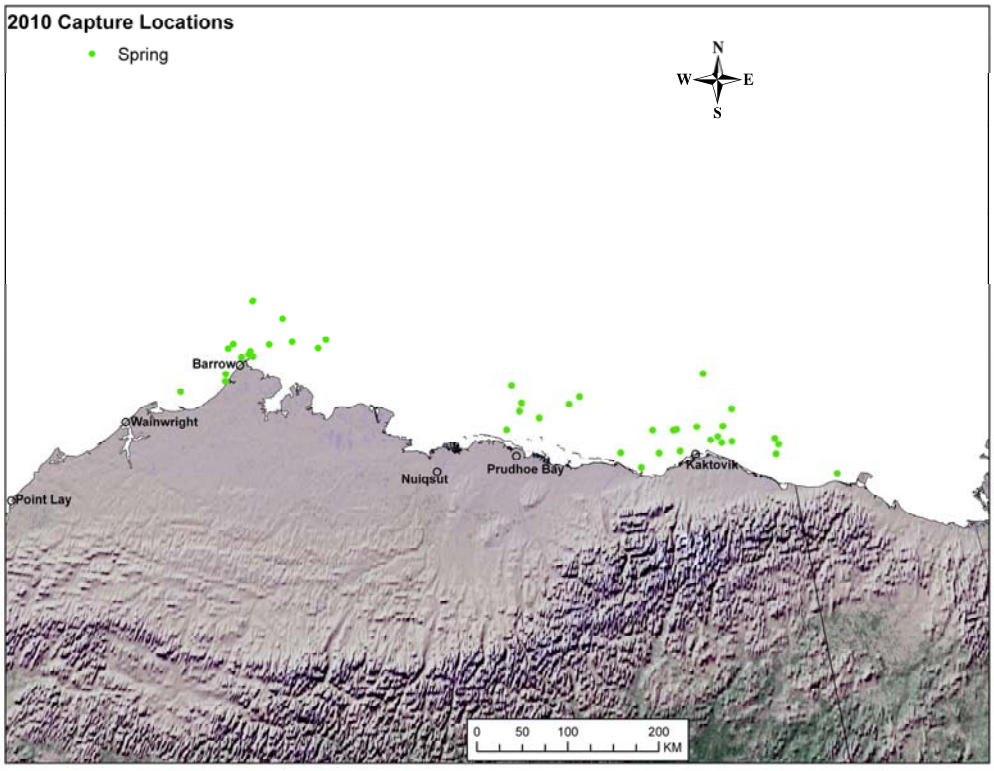


Figure 1. Capture locations for U.S. Geological Survey southern Beaufort Sea polar bear research in 2009 (a; 122 captures) and 2010 (b; 76 captures).

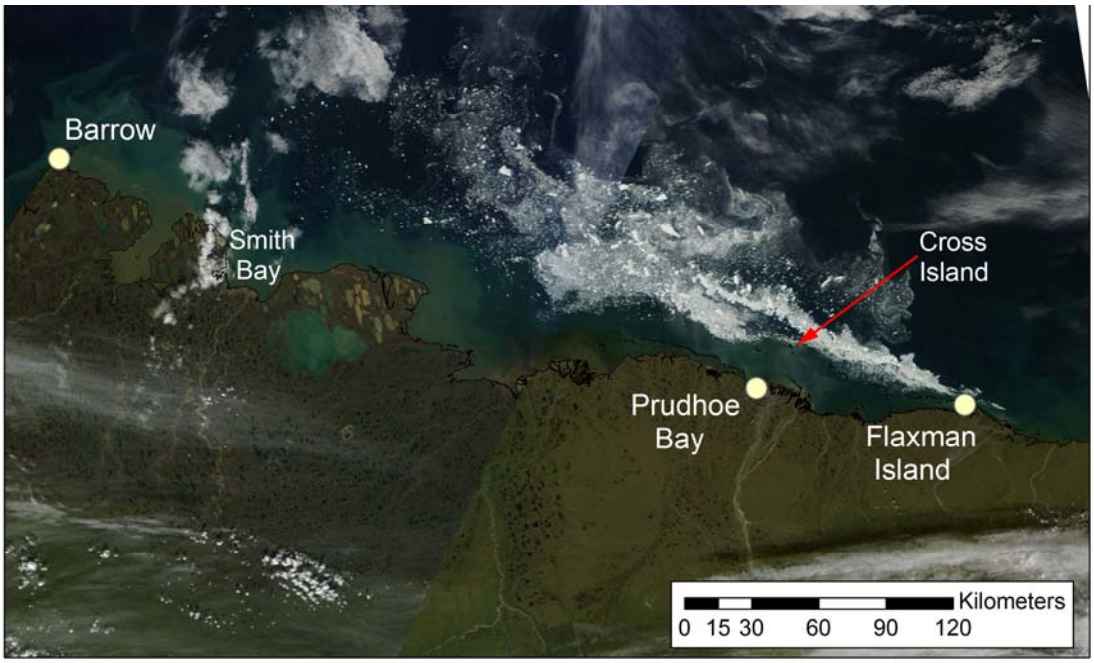


Figure 2. MODIS image, 14 August 2010, for the southern Beaufort Sea adjacent to the Alaska coast showing a remnant patch of sea ice that persisted throughout much of summer and autumn 2010 from Flaxman Island to Smith Bay and north 50-60 miles.
http://rapidfire.sci.gsfc.nasa.gov/subsets/?subset=AERONET_Barrow.2010226.terra.250m.

Figure 3. Helicopter view (~600 m asl) north to Cross Island and sea ice, 14 August 2010. Sea ice was estimated to be 10-25 % aerial concentration and extended from Flaxman Island to Smith Bay and north 50-60 miles.

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Submitted

Amstrup, S. C., E. DeWeaver, D. C. Douglas, B. G. Marcot, and G. M. Durner. Submitted. Reduced greenhouse gas emissions improve polar bear forecasts.

Durner, G. M., A. S. Fishbach, S. C. Amstrup, and D. C. Douglas. In prep. USGS catalogue of polar bear maternal den locations in the Beaufort Sea and neighboring regions, 1910 – 2010. USGS Data Series xxx

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Published

Amstrup, S.C., H. Caswell, E. DeWeaver, I. Stirling, D.C. Douglas, B.G. Marcot, and C.M. Hunter. 2009. Rebuttal of "Polar Bear Population Forecasts: A Public-Policy Forecasting Audit. Interfaces. *Articles in Advance*. Pp. 1-17.

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